CLIMATE NARRATIVE, December 2020 and as noted

How will we predict the future if we cannot see the present?
Climate_Narratives may be found,
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html Jerrold.G.Norton@noaa.gov

UNITED STATES WEST COAST AND NORTH PACIFIC

During late **December** 2020 average to below average sea surface temperatures (neutral to negative SST_D anomalies from 0°C to -2°C) occurred coastally (20-300 km offshore) from Central America to Northern California (5°-41°N). Off the U.S. west coast, these areas were most developed in intensity and offshore extent (300-700 km) from southern California to Cape Mendocino (33°-40°N). Neutral to positive SST_D anomalies along coastal Canada and Alaska replaced the negative SST anomalies of November. A band of anomalously high SST_D persisted across the Pacific. The band occurred between 30°-44°N off North America and between 10°S -45°N in the western Pacific. Between 5°S-5°N, a tongue of negative SST_D anomaly reached from the coast of South America westward to beyond 160°E, as La Niña conditions continued during December.

https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/ https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://coastwatch.pfeg.noaa.gov https://climatereanalyzer.org/wx/DailySummary/#sstanom (current)
https://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html
https://www.fisheries.noaa.gov/feature-story/central-gulf-alaska-marine-heatwave-watch?utm_medium=email&utm_source=govdelivery

Sea Level Height Anomaly (SLA) analyses during late December for the Pacific Ocean (30°S-40°N) showed weakening negative SLA (≥-20 cm) along the coast of North America from the equator northward to beyond 40°N, coincident with negative coastal SST_D anomaly. Between 0°-15°N these negative SLA anomalies (≥-20 cm) extended from the coast to the date line (180°E/W). The most developed troughs occurred within 20° N/S of the equator between 115°W and 155°W. At 150°E, in the western Pacific, positive SLA anomaly (≥20 cm) occurred from the equator to 20°N, where there was transition to negative SLA that extended to 30°N. North of 35°N, SLA was positive from 140°E across the north Pacific.

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/weeklyenso_clim_81-10/wksl_anm.gif (current)

During late December, coastal areas with **surface chlorophyll-a** (chl-a) concentrations of 0.5- 2.0 mg/m^3 were seen in NOAA / VIIRS satellite imagery along the coast of North America from 28°N to 52°N. This coastal zone of high chl-a reached 400-800 km off the U.S. The higher concentrations occurred within 200 km of the coast between 33°-40°N. North of 47°N, patches (>10^5 km^2) of elevated chl-a reached from the U.S coast across the north Pacific. Coastal areas with 0.4-1.5 mg/m^3 were generally 50-150 km off offshore southern California and northern Mexico (30°-32°N). Lower chl-a oceanic water (0.04-0.09 mg/m^3) occurred within 150 km of shore south of 30°N and across the temperate Pacific. https://coastwatch.pfeg.noaa.gov/coastwatch/CWBrowserWW180.jsp#
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVHNchla8day.graph?chla%5b(2021-12-31T00:00:00Z)%5d%5b(0.0)%5d%5b(83.65125):(-0.10875)%5d%5b(-180.03375):(-110.00625)%5d&.draw=surface&.vars=longitude%7Clatitude%7Cchla&.colorBar=%7C%7C%7C%7C%7C%7C&.bgColor=0xffccccff

Monthly sea temperature list from shore stations and **near-shore buoys**

The following list gives shore and nearshore water temperature measurement locations along the U.S. west coast in decreasing latitude. Each line begins with a shore

station or buoy abbreviation followed by latitude. Temperature values are in brackets with the average of available month's values first (followed by the range and standard deviation) in parenthesis and change from previous monthly mean. Temperature averages for the first, second and third monthly terciles are within the second parenthesis, followed by the multiyear monthly average, where available. Subscripts H and L show the tercile where the highest and lowest month's temperatures were recorded.

Negative changes in average temperature from November to **December** show continued inshore cooling. In addition: 1) temperature range of monthly averages was 8.5°-15.5°C, 2) monthly averages are at or below available multiyear averages, 3) highest (H) and lowest (L) temperatures showed some consistency at locations listed adjacently, but there was little overall pattern from 32.9°N to 48.4°N. 4) standard deviations of the monthly mean were generally 0.2-0.4 from 37.8°N (SFrn) to 48.4°N (*NeBy*) and 0.4-0.6 south to 32.9°N (*LaJo*).

Cape Flattery 48.4°N

NeBy,48.4° *[8.5(7.5, 9.2, 0.29)-1.0(8.7$_H$, 8.5, 8.3$_L$)°C]*

CpEz,47.4°N,124.7°W [9.9 (8.6, 10.3, 0.26)-0.6(10.0$_H$, 9.6$_L$, 10.0$_H$) 11.1°C]

AsCn,46.1°N, 124.6°W [10.2 (9.4, 11.0, 0.39)-1.4(10.5$_{LH}$, 10.2$_L$, 10.0)°C]

Cape Blanco 42.8°N

PrtO,42.7°N *[10.3(9.7, 11.1, 0.27)-0.3(10.3$_L$, 10.2$_{LH}$, 10.4$_H$)°C]*
CCty,41.7° *[10.1(9.3, 10.7, 0.25)-0.4(10.2$_H$, 10.2$_H$, 10.0$_L$)°C]*
EelR,40.7°N, 124.5°W [10.7 (9.0, 11.5, 0.30)-0.5(10.5$_L$, 10.7$_H$, 10.8) 10.9°C]

Point Arena, 39°N

ArCv,38.9°N *[10.6(9.7, 11.1, 0.22)-0.5(10.5, 10.6$_H$, 10.6$_{LH}$)°C]*

Point Reyes, 38°N

SFrn,37.8°N,122.8°W [11.2(10.7, 12.0, 0.22)-1.1(11.4$_H$, 11.2, 10.9$_L$) 11.8°C]

MnBy,36.6°N, 121.9°W [11.7(10.9, 12.8, 0.43)-1.6(11.3$_L$, 11.8, 11.9$_H$)°C]
PtSr, 36.4°N, 122.1°W [12.0(11.0, 13.1, 0.50)-1.0(11.6$_L$, 12.5, 12.0$_H$)13.6)°C]

Point Sur, 36.3°N

PrtS,35.1°N *[12.5(12.1, 13.0, 0.20)-1.1(12.4$_L$, 12.7$_H$, 12.5)°C]*
PtCn,34.5°N,120.8°W [13.6(12.6, 14.9, 0.38)-0.3(13.7$_{LH}$, 13.6$_H$, 13.5)°C]

Point Conception, 34.4°N

SBCh,34.3°N,119.9°W [14.4(13.5, 15.2, 0.33)-0.9(14.7$_H$, 14.4$_H$, 14.2$_L$) 14.5°C]
SMca,34°N *[14.8 (13.8, 15.8, 0.49) -0.7 (15.3$_H$, 14.7$_L$, 14.4$_L$)°C]*

Tory,32.9°N,117.4°W [14.9 (13.7, 16.2, 0.58)-1.6 (15.0$_H$, 15.4$_H$, 14.4$_L$) 16.1°C]
LaJo,32.9°N *[15.5(14.6, 16.7, 0.51)-1.0(15.9$_H$, 15.5$_H$, 15.1$_L$)°C]*

Point Loma, 32.7°N

Shore temperature measurements, taken at fixed depth below the lowest tide at NOAA **tide stations**, are in italics: *NeBy* (9443090), *PrtO* (9431647), *CCty* (9419750), *ArCv* (9416841), *Mtry* (9413450), *PrtS* (9412110), *SMca* (9410840), *LaJo* (9410230).

(Numbers) lead to detailed location and station descriptions,
https://tidesandcurrents.noaa.gov/stations.html?type=Physical%20Oceanography

. Near shore buoy measurement details are obtained from number designations: Neah (46087), CpEz (46041),TlMk (46089), EelR (46022), SFrn (46026), PtCn (46218), SBCh (46053), Tory (46225). https://www.ndbc.noaa.gov/station_page.php?station=46087 * indicates partial record

EQUATORIAL AND SOUTH PACIFIC

During **December**, La Niña (cool phase ENSO) conditions occurred across the central and eastern equatorial Pacific (EP). La Niña conditions are expected (95%) to continue through the northern winter and modeling results suggest a greater than 50% chance of it continuing through April. East of 150°W negative EP temperature anomalies (≥ -2.5°C) persisted from the surface to 200 m. The eastern EP upper 300 m heat content anomaly decreased sharply through October with the lowest, most negative, 2020 value occurring in the first days of November. Then the heat content anomaly increased 20%-30% through November and December. During December, negative sea surface temperature (SST_D) anomalies occurred in spatially intermittent patterns around Antarctica and across the southern Indian, Atlantic and Pacific Oceans. Globally, the largest areas of negative SST_D anomalies were across the EP and off the South American coast west to135°W. West of 168°E, positive SST_D anomalies (≤1.5°C) were seen from 30°S to 30°N.
https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://coastwatch.pfeg.noaa.gov https://climatereanalyzer.org/wx/DailySummary/#sstanom (current)
https://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html

During late December **sea level height anomaly** (SLA) was negative (≥-25 cm) along the coast of North and South America between 30°S-40°N. These areas extended to 170°E in the EP and to 140°W at 20°S. In the western Pacific, positive SLA anomaly (≤20 cm) occurred from 30°S northward across the equator into Indonesian Seas.
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/weeklyenso_clim_81-10/wksl_anm.gif (current)

The NOAA **Oceanic El Niño Index** (ONI) (3-month running mean of ERSST.v5 anomalies in the Nino 3.4 region) during May-June-July (MJJ), JJA, JAS, ASO, SON and OND were -0.2, -0.4, -0.6 -1.0, -1.2 and -1.3, respectively, tending toward La Niña designation thresholds. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf
https://climatedataguide.ucar.edu/climate-data/multivariate-enso-index (alternate El Niño index)

The NOAA/PSL **Southern Oscillation Index** (SOI) values for January-December 2020 are 0.30, -0.10, -0.20, 0.30, 0.70, -0.60, 0.70, 1.80, 1.50, 0.80, 1.10 and 3.0, respectively. Positive values are associated with negative phase ENSO (La Niña).
https://psl.noaa.gov/data/correlation/soi.data https://psl.noaa.gov/site_index.html#s https://www.longpaddock.qld.gov.au/soi/

The NOAA/NCEI **Pacific Decadal Oscillation Index** (PDO), calculated from the North Pacific ERSST.v5 was consistently negative, -1.20, -1.01, -0.61, -1.65, -1.02, respectively, for August through December. https://www.ncdc.noaa.gov/teleconnections/pdo/ ,
http://research.jisao.washington.edu/pdo/PDO.latest.txt

The **Pacific / North American Teleconnection Index** (PNA), computed from atmospheric pressure over the Pacific Ocean and North America had predominately positive values during December with a monthly "Historical PNA Index" value of 1.28,

the strongest positive value of 2020. Negative phase PNA is associated with negative phase ENSO. https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml (Historical Index)
https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml (computational alternatives).

December monthly ERD/SWFSC coastal **Upwelling Indices** (UI) were weakly positive from Mexico to central California (24°-39°N). UI values were negative from 42°N to the Gulf of Alaska (60°N). Large negative UI values and anomalies occurred at 51°N and 54°N showing the strong cyclonic forcing of winter storms. Daily UI values for 33°N off southern California were positive and negative through the month with a moderate upwelling event during 10-18 December
https://upwell.pfeg.noaa.gov/products/PFELData/upwell/monthly/table.2012
https://oceanwatch.pfeg.noaa.gov/products/PFELData/upwell/daily/p11dayac.all (see computational alternatives)
https://oceanview.pfeg.noaa.gov/products/upwelling/dnld (current)

PRECIPITATION and RUNOFF

During the final days of December, water year (October-December) precipitation was about average (90-120%) on the Columbia River and in western Washington. Western Oregon averages ranged from 57-96 %, with water deficits of one to 12 inches. Northern California precipitation ranged from 85% of average at the border to 30% at San Francisco. Crescent City in northern California had more than 14 inches, but total rainfall was 54% of average for the water year. Southern California had little precipitation. At the end of 2020 much of Oregon, California and the western U.S. remained in drought conditions.
https://droughtmonitor.unl.edu. https://waterdata.usgs.gov/ca/nwis/nwis
https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=4
https://waterdata.usgs.gov/ca/nwis/current/?type=flow https://watermonitor.gov/naww/index.php
https://www.cpc.ncep.noaa.gov/products/global_monitoring/precipitation/global_precip_accum.shtml

Northwest and Washington River Discharge

Fraser River discharge, measured at Hope (130 km upriver from Vancouver, B.C.) increased to a maximum of 2020 m^3/s (71,346 cfs) in early **December** and fell to 1,000 m^3/s (35,320 cfs) by 30 December. Median discharge for this station during this highly variable period is 700 m^3/s (24,724 cfs). Some precipitation held as snow.
https://wateroffice.ec.gc.ca (Station 08MF005)

The **Queets** at Clearwater, Washington was flowing at 28,200 [4,670/ 23,970 cfs], [historical median / change from November to **December** as cubic feet per second, cfs, in brackets]. The **Puyallup** at Puyallup was flowing at 8,670 [3,320/ 7,410 cfs]. **Skagit** flow was 44,000 [15,200/ 26,300 cfs] near Mount Vernon. **Stillaguamish** discharge was 8,810 [1,810/ 6,930 cfs] at Arlington, Washington.

Oregon River Discharge

The **Columbia** at The Dalles, Oregon was 108,000 [107,000/ -29,100 cfs]. The **Wilson** at Tillamook, was flowing at 13,400 [1,660/ 758 cfs]. At Elkton, **Umpqua** transport was 12,800 [8,930/ 10,190 cfs]. **Rogue** River flow was 2,330 [2,940/ 1000 cfs] at Grants Pass and 6,980 [5,490/ 5,090 cfs] at Agness, Oregon.

California River Discharge

The **Klamath** near Klamath, California was transporting 11,100 [13,800/ 7,880 cfs]. **Smith** discharge was 12,900 [4,440/ 12,130 cfs] near Crescent City. The **Eel** at Scotia had 9,420 [10,400 cfs] transport. The **Eel** at Scotia had 1,600 [8,410/ 1,174 cfs]

transport. The **Battle Creek,** Coleman National Fish Hatchery flow was 235[376/ 15 cfs]. **Butte Creek** at Chico had 113 [253/ 17 cfs] transport (see notes below). **Sacramento** transport was 7,120 [15,100/ -1,150 cfs] at Verona. **San Joaquin** flow was 975 [2,330/ 120 cfs] at Vernalis. **Pescadero Creek** transported 1.2 [3.0/ -0.6 cfs] near Pescadero. **San Lorenzo** River discharge was 2.2 [23.6/ -10.7 cfs] at Santa Cruz. The **Pajaro** at Chittenden was flowing at 2.3 [12.5/ -2.1 cfs]. The **Salinas** River had no measurable surface flow at Spreckels from 30 September through 31 December. The **Carmel** at Carmel was flowing at 2.7 [6.1/ -1.8 cfs]. The **Big Sur** River near Big Sur, California discharged at 4.4 [19.7/ -14.6 cfs] in the final days of December 2020.
https://droughtmonitor.unl.edu. https://waterdata.usgs.gov/ca/nwis/nwis
https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=4
https://waterdata.usgs.gov/ca/nwis/current/?type=flow https://watermonitor.gov/naww/index.php
https://www.cpc.ncep.noaa.gov/products/global_monitoring/precipitation/global_precip_accum.shtml
https://www.wrh.noaa.gov/cnrfc/rsa_getprod.php?prod=RNORR4RSA&wfo=cnrfc&version=0

Notes for December

During 2020, the early season (spring and summer) return of 143,800 **Chinook Salmon** at Bonneville Fishway, 235 km up the **Columbia River**, was about 65% of the average for the last ten years. This was better than 2019, when adult early returning adults were only 48% of the 10-year average. Returns in 2020 were about the same as 2018. Early season returns have been lower than average during the last four years, after above average returns during 2010-2016. An additional 16% early returning Chinook are immature fish (Jacks), that may add diversity to the spawning population. Over the last 10 years early returning Columbia River Chinook constituted about 30% of total Chinook passing through the Bonneville Fishway. All-season adult Chinook passage at Bonneville was 73% of the 10-year average, the best all-season Chinook passage of the last four years. Chinook also spawn in Columbia River tributaries between Bonneville Dam and the ocean. https://www.fpc.org/web/apps/adultsalmon/Q_adultcounts_annualtotalsquery.php

Although early season, **spring run Chinook** were once the most abundant salmon run in the **Sacramento-San Joaquin** drainages, the largest current population of spring Chinook spawns in Butte Creek, off the Sacramento River. During 2020, snorkel in-water estimates in Butte Creek totaled about 1,600 spawning adults. This count was less than 50% of the 2019 returns, but better than 2015 and 2017 and similar to 2018 returns. More than 12,000 adults returned to Butte Creek during 2013 and 2014. Year-to-year return variability increased after 2008. Jessica.nichols@wildlife.ca.gov.